

stomella the most elementary variety of the type is found in the thin-shelled, simple *Nonionina depressula* of brackish-water pools, whilst *N. asterizans* and *Polystomella crispa* lead up to the complex *P. craticulata*, which is the parallel of the highest Rotalians. In like manner with *Nummulina*, though, as might be expected, the successive steps of differentiation are more distinct, and, as far as our present knowledge goes, further apart, it appears more consonant with analogy and more in accordance with natural order to regard *Archaeodiscus* and *Amphistegina* as closely related forms of inferior organisation leading up to the perfect type. The striking similarity in the general minute structure of the shell in these reputed Nummuline forms is confirmatory evidence not without value. The alterations rendered necessary by the adoption of the "presence of a canal-system," as the essential character of the family, could not stop where Dr. Zittel has left them; *Nonionina* and *Fusulina* would have to be transferred to the GLOBIGERINIDA, whilst *Calcarina*, *Tinoporus*, and some of the true *Rotaliae* must under the restricted definition be severed from their natural allies to be placed amongst the NUMMULINIDA—changes that would find but little favour amongst students of the Rhizopoda.

There are many other little points in connection with the treatment of the Foraminifera that are open to criticism, favourable or otherwise, but as they do not affect the general usefulness and value of the work, it is needless to extend an already lengthy notice by their examination.

The RADIOLARIA, better known perhaps under Ehrenberg's name "Polycystina," form a much more manageable Order, and one which, in the present state of our knowledge, lends itself comparatively readily to artificial subdivision. The literature of the subject too is comparatively limited—that of the successive stages of investigation being summarised in the standard memoirs of Professors Ehrenberg, Johannes Müller, and Ernst Haeckel. The classification adopted by Prof. Zittel is with but little modification that elaborated by Prof. Haeckel for his magnificent monograph. The entire Order is divided into fourteen principal Groups, founded for the most part on the geometrical characters of the silicious skeleton. Out of the fourteen Groups, notwithstanding the enormous number of individuals and of species found in the early and middle Tertiary deposits of Barbados, Bermuda, North America, and the Mediterranean borders, only about one-half are known to have fossil representatives.

The Radiolaria make their appearance at a much later period of the earth's history than the Foraminifera and the part they have had to play in the formation of successive geological deposits has been a much less important one. Doubtful specimens have been found as far back as the Triassic beds of St. Cassian, but of too obscure a nature to yield satisfactory evidence as to geological range, and the same may be said of some that have been described of Jurassic age. In the Upper Chalk, however, well-defined and characteristic forms have recently been discovered by Dr. Zittel. In the earlier part of the Tertiary epoch the group assumes considerable importance, and from that time to the present Radiolaria have formed a frequent if not a constant element of the fauna of deep water.

The first part of the "Handbook" refers, in the main,

to fossils belonging to one division of the Animal Kingdom, and it has therefore been necessary to dwell on points in which the mode of treatment differs from that which has hitherto prevailed, but the questions which have been adverted to in detail have a special and limited bearing, and do not materially affect the work in its wider aspect as a manual of palaeontology. Of its excellence, when complete, as a student's text-book, and of its prospective value to the working palaeontologist, the present instalment gives abundant promise.

There is but a word to add on the illustrative wood-cuts. To those who recollect the beautiful drawings that accompany that section of the "Novara-reise," which is devoted to the Foraminifera of Kar Nikobar, the name of Dr. Schwager will be sufficient guarantee for accuracy and finish, and it is only needful to say that the draughtsman's hand has lost none of its cunning and that in the present work the illustrations, which are for the most part new, are singularly apt and effective, though, in the copy before us, occasionally somewhat marred by defective printing.

H. B. BRADY

OUR BOOK SHELF

Handbooks for the Glasgow Meeting of the British Association.—I. "Notes on the Fauna and Flora of the West of Scotland." 2. "Catalogue of the Western Scottish Fossils." 3. "Notices of some of the Principal Manufactures of the West of Scotland." (Glasgow: Blackie and Son, 1876.)

As there are satisfactory guide-books to Glasgow and the West of Scotland already in existence, it would have been superfluous in the Local Committee to have compiled another general work of the same kind. It was, however, a happy idea to publish the three volumes which we have only now received, as they contain just such special information as cannot be readily obtained, but which it is to be supposed the many votaries of science who were recently assembled in Glasgow would be glad to be furnished with. The volumes are well printed, of a handy size, and, so far as we have been able to test them, carefully compiled by competent men. In the volume devoted to the fauna and flora, Mr. E. R. Alston describes the mammalia, Mr. Robert Gray the birds, Mr. Peter Cameron the insects, Mr. James Ramsay vascular flora, and Dr. J. Stirton the Cryptogamic flora. To vol. iii. is prefixed an Introduction by Prof. Young, on the geology and palaeontology of the district, the catalogue itself being compiled by Messrs. James Armstrong, John Young, F.G.S., and David Robertson, F.G.S. This volume is illustrated with four plates of fossils. In the volume devoted to manufactures, Mr. St. John V. Day writes on the iron and steel industries, Mr. John Mayer on the engineering and ship-building industries, Mr. James Paton, Curator of the Glasgow Industrial Museum, on the textile industries, and Prof. John Ferguson on the chemical manufactures. Considering the haste with which these volumes must have been compiled, they are wonderfully complete and well arranged, and if the publishers are careful to keep them up to date and extend them in a new edition, they might become of permanent value. Prefixed to each volume is a sketch map of the country surrounding Glasgow, with its general geological features.

The Tree-lifter; or, A New Method of Transplanting Forest Trees. By Col. George Greenwood. Third Edition. (London: Longmans, Green, and Co., 1876.)

THIS is a book of some two hundred and thirty odd pages, eleven pages of which are devoted to a description of the

tree-lifter and of its advantages in transplanting large trees. The principle of transplanting trees with a large ball of earth attached to the roots is, however, so well known, and tree-lifters of similar construction to that here described are now so generally used, that we follow the example of the author in his brevity, and simply dismiss this part of the subject which he calls the "practical part of transplanting," and turn to Part 2, which is devoted to the "theory of transplanting, or physiology of trees in reference to transplanting." It is apparently for the purpose of recapitulating and condensing the views of various authors of acknowledged reputation in the several branches of vegetable physiology, and of expressing his own opinions thereon, that the author has put this book together, all that is really directly connected with the title being contained, as we have before said, in the first eleven pages. The author, however, at the beginning of Part 2, candidly says: "Before entering on physiology, I would say one word to defend myself from the charge of egotism and plagiarism. When I mention Sir Humphry Davy, I may say that immortal names are among those who have written on the physiology of trees; yet so much doubt and difference prevail among the authors on the subject, that one cannot adopt a single opinion without opposing many, held by minds, perhaps, as clear and comprehensive as Sir Humphry's. It is, then, to save the reader's time if I lay down as certain what men have doubted or controverted, or if I use the words, 'I think this,' or 'I think that,' in stating other people's opinion."

Space will not permit us to follow the author through all his reasonings; it will suffice to mention that no less than forty-one pages are given to the consideration of the subject of the course of the sap, in which the author tilts at several well-known English and Continental botanists whose theories are adverse to his own. Lindley is the most recent authority quoted in the original edition, and the opinions of later writers have not been embodied in subsequent issues. What we have already said will show the character of the book. The style of writing may be gathered from the first paragraph in the chapter on the course of the sap, where the author says: "However much we may dispute on *how* the sap gets into the tree, we shall all agree that it *does* get in somehow; and but for Dr. Lindley, I believe we should all agree on the *course* which it then takes." Further on, in connection with the theories of the contraction and expansion of the wood, caused by alternating heat and cold, and of the pumping action from the motion caused by wind, Col. Greenwood writes: "Look into the hot-house and the hot-bed. In these neither of these causes exists. Not a breath of wind enters; nor is any alternation of heat and cold allowed. Yet in these the ascent of the sap is freest. And if we look out of doors, I should say that the sap would be a slow traveller if its ascent depended on wind and cold. Here, then, I cannot back the favourite, and have a sort of blind leaning for *Turgescence*, or *Swelling*, a dark horse, certainly, and I am all in the dark about him myself;" and the author is in a similar state of gloom upon other points besides.

Practical Portrait Photography. By Wm. Heighway. (London: Piper and Carter, 1876.)

THE author of this little book of 152 pages has endeavoured to "provide simple and intelligible rules of working," as he states in his introduction, so that those who take up photography as an art should be helped over a number of difficulties certain to occur, and not always provided against in more ambitious works. The lessons chiefly enforced are cleanliness and accuracy in preparing the requisite solutions, and method in carrying out the rest of the processes; though these lessons may seem trite to the regular student of science, they are no doubt much needed amongst photographers who are not at the same time practised chemists.

The necessary instructions are well and carefully given, and the author has omitted no point of importance, taking the reader *seriatim* through every detail, from cleaning the glass plate to finishing the paper print.

We notice some errors in chemistry, where the author has given reasons for some of the processes, which we hope will be corrected in a future edition. R. J. F.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

On the Discovery of Palæolithic Implements of Inter-glacial Age

THE opinion that palæolithic man was a post-glacial being has been steadily losing ground among certain geologists whose studies render their opinions of considerable weight. Mr. Pen-gelly and Prof. Ramsay have stated their conviction that the old stone folk may have witnessed the commencement of glacial conditions, and have been driven south by the increasing severity of the climate. Prof. Dawkins has expressed his belief that while our rude ancestors hunted the elephant, glaciers still lingered in our mountain-valleys. Mr. Tiddeman goes further, and ascribes to them an inter-glacial age, and, as it seems to me, proved his point by the discovery of implements and a human bone beneath glacial-clay in the Settle Cave. Mr. James Geikie boldly advanced the opinion that *all* our palæolithic implements are of inter-glacial age, and an intimate knowledge of the glacial beds and gravels of the central and eastern counties led me independently to a similar conclusion. In making this last statement I particularly desire it to be understood that no claim is preferred to the theory as my own, for while I was almost fearful of my temerity in even thinking such things, my friend Mr. Geikie had brought his great stores of knowledge to bear upon the point, and has made it peculiarly his own. Nevertheless the fact that two geologists working independently in different districts should arrive at similar conclusions is no mean argument in our favour. The evidence upon which my convictions are based is given in my "Geology of the Fenland," and in my "Manufacture of Gun-flints," &c., to be shortly issued by the Geological Survey, and in the forthcoming edition of the "Great Ice Age."

Mr. Geikie has proved, and the work of Mr. Tiddeman, myself, and others, has confirmed the observations that the glacial epoch, instead of being an uninterrupted period of cold, was one of fluctuating climate, there being known at least four ice ages with intervening cold, mild, and warm epochs. The greatest severity of cold took place towards the early part of the Great Ice Age, and the great chalky boulder-clay which extends nearly to the Thames was then formed; no subsequent ice-sheet having left its traces further south than Lincolnshire. Travelling northwards from East Anglia we find this boulder-clay running under the purple boulder-clay, and this again overlaid still farther north by a yet newer glacial bed. These are well-known facts accepted by all geologists, but as the old chalky boulder-clay has unfortunately been named the "upper" boulder-clay, it has been supposed to mark the close of the glacial epoch, whereas it is only "upper" so far as East Anglia is concerned, and merely marks the last glaciation of that area, the more northern districts having been more than once glaciated since then. The East Anglian "upper" boulder-clay is probably as old as the Lancashire "lower" boulder-clay.

In consequence of this confusion of terms, the beds which overlie the chalky boulder-clay have been confidently relegated to post-glacial times, whereas all that can be determined by this superposition is that they are "post-boulder-clay." From valley and other gravels occupying such positions, great numbers of palæolithic implements have been obtained, especially from the basins of the rivers Lark and Little Ouse. Wherever bones are found in these gravels they belong to what Prof. Dawkins calls the pleistocene, and not to the pre-historic fauna; and this mammalian fauna is continued into the estuarine gravels of the Fenland, which contain extinct shells, such as *Cyrena fluminialis*, a shell which has often been found in gravels yielding palæo-